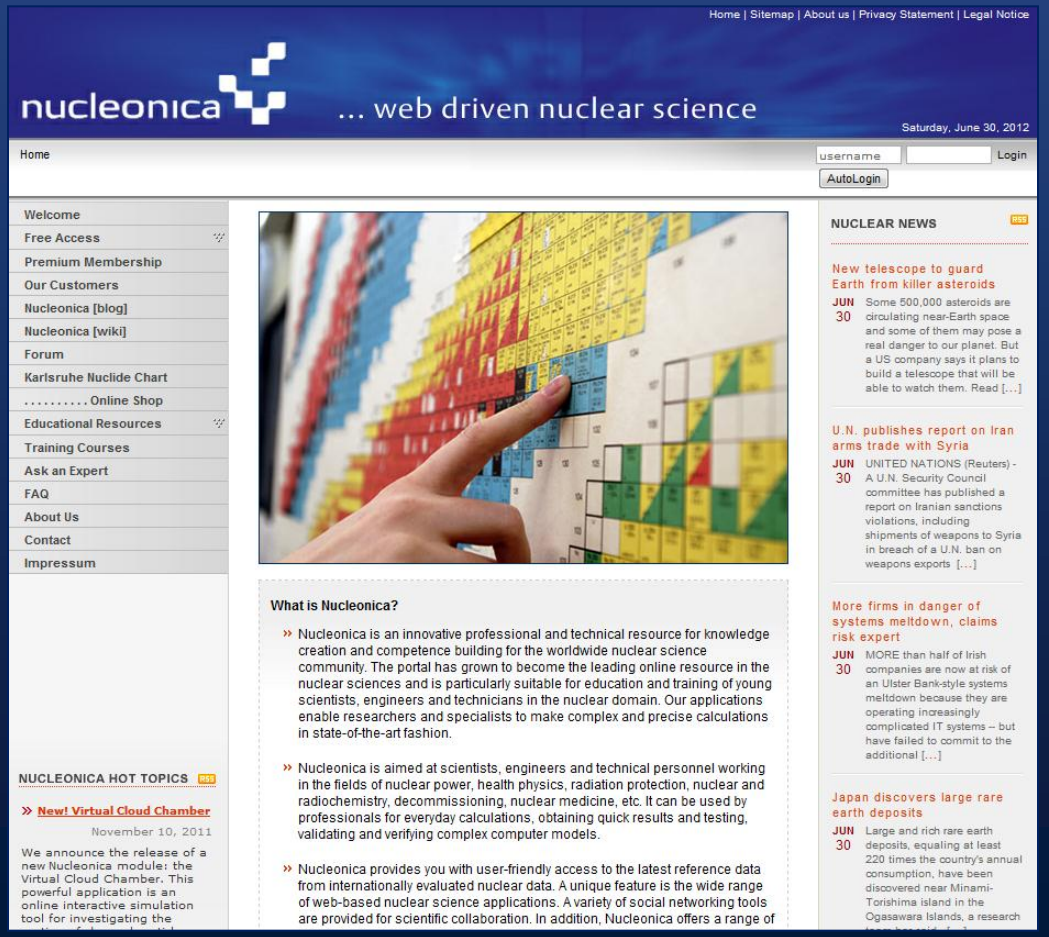
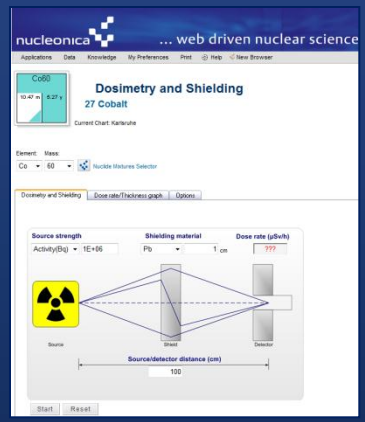
Training Course / Nucleonica Overview

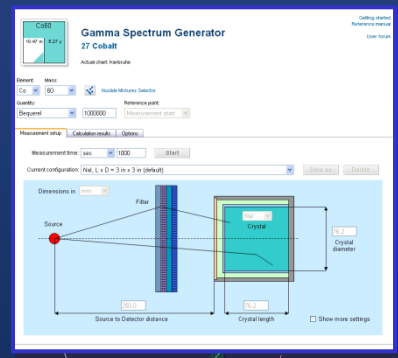
Dr. Joseph Magill,
Nucleonica GmbH,
Karlsruhe

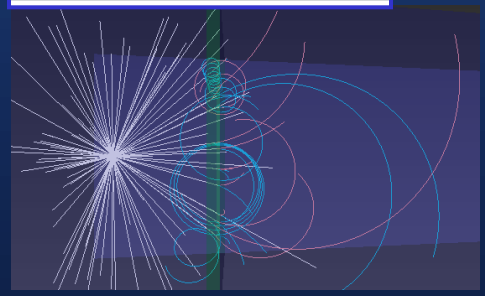


Nucleonica: Web-based Software Tools for Simulation and Analysis

- Nuclear Data Resources in Nucleonica
- Nuclear Science Applications & Tools
  - Decay Engine
  - Dosimetry & Shielding
  - Virtual Cloud Chamber
  - Gamma Spectrum Generator
  - webKORIGEN
  - *e*-Ship
- Education & Training with Nucleonica
  - Post Grad. Research
  - Nucleonica Mobile
  - Karlsruhe Nuclide Chart
- Knowledge Management with Nucleonica

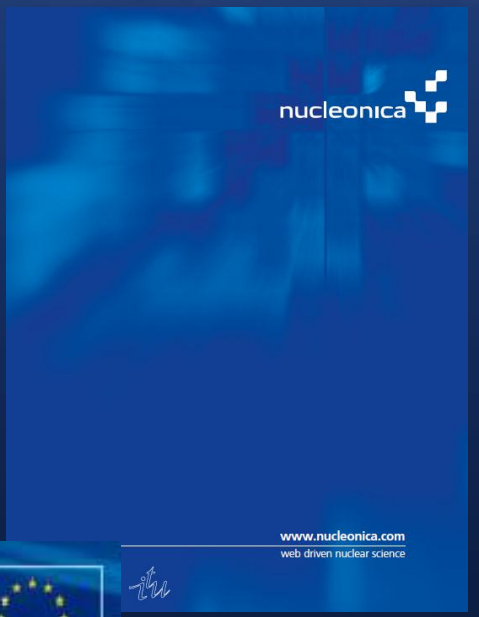






How can Nucleonica help you?

- Nucleonica provides you with user friendly access to the latest reference data from internationally evaluated nuclear data.
- A unique feature is the wide range of validated web-based nuclear science applications for decay calculations, dosimetry & shielding, gamma spectrometry, etc.
- In addition Nucleonica offers a range of introductory and advanced training courses in various areas of nuclear science.

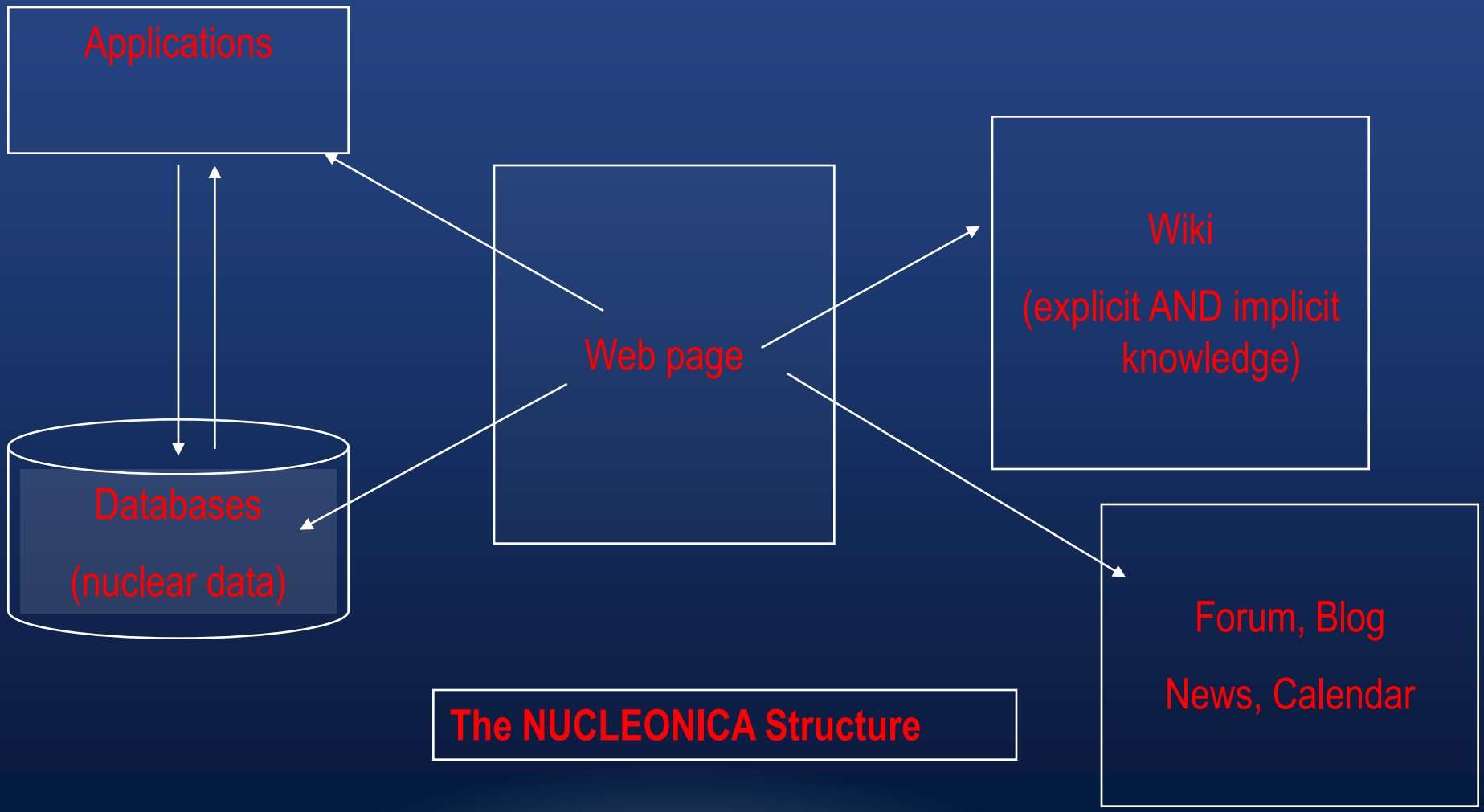


CERN · PAUL SCHERRER INSTITUT PSI · TRIUMF · Bundesamt für Strahlenschutz · JÜLICH FORSCHUNGSZENTRUM · SCK·CEN · WAK · HZB Helmholtz Zentrum Berlin

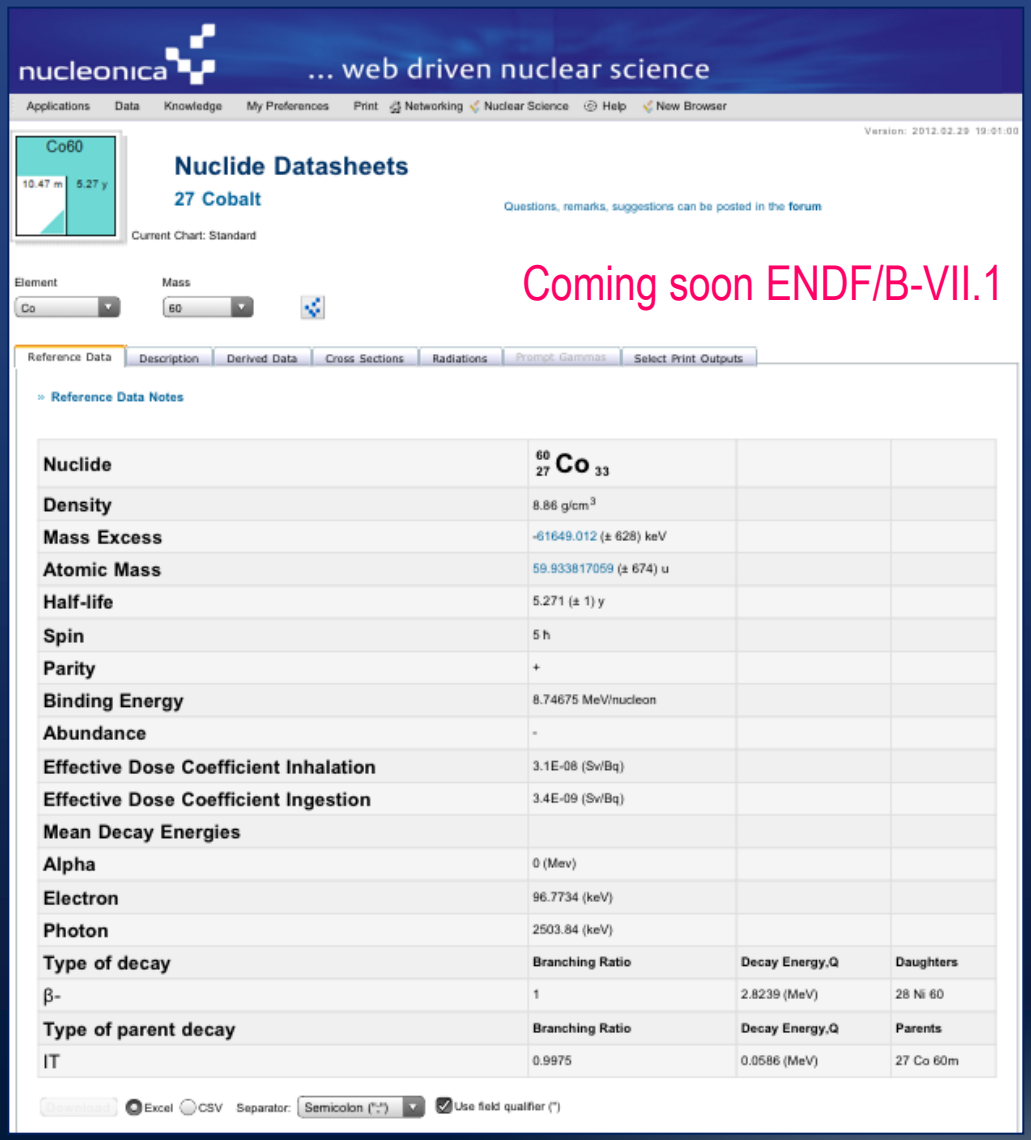
Nucleonica is already being used by thousands of scientists and students worldwide in over 92 countries. Due to its advanced IT features, user friendly and intuitive environment, the platform has recently been endorsed by the Sustainable Nuclear Energy Technology Platform (www.snetp.eu):

"Nucleonica plays … an important role in making nuclear education more attractive and in building nuclear knowledge for a new generation of engineers and scientists"

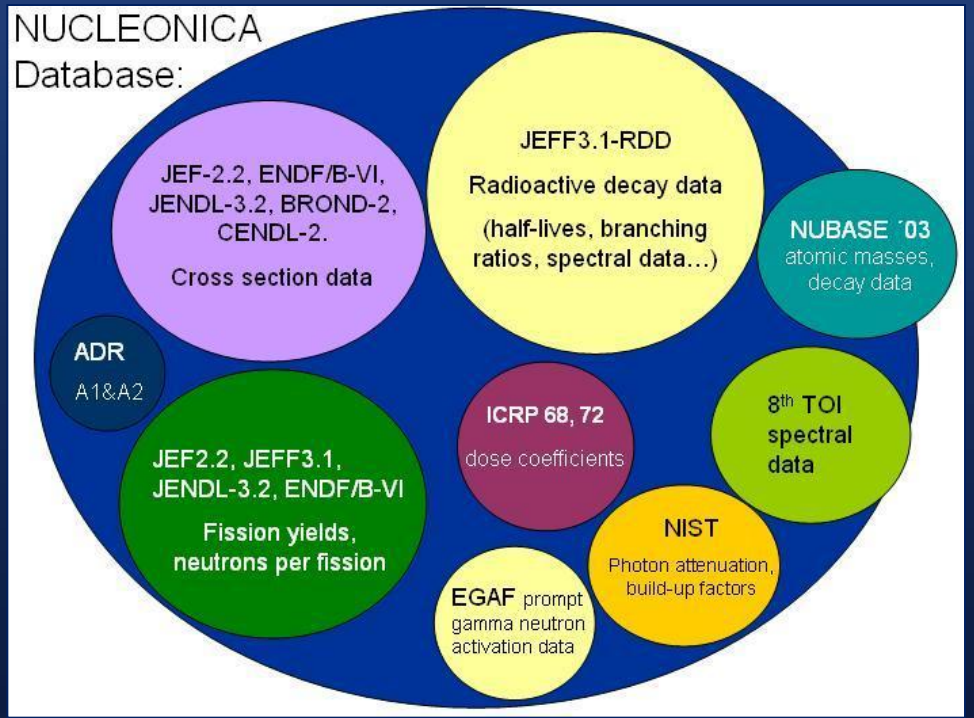
Nucleonica Architecture & Logical Structure…



Nuclear Data Resources in Nucleonica: Nuclide Datasheets



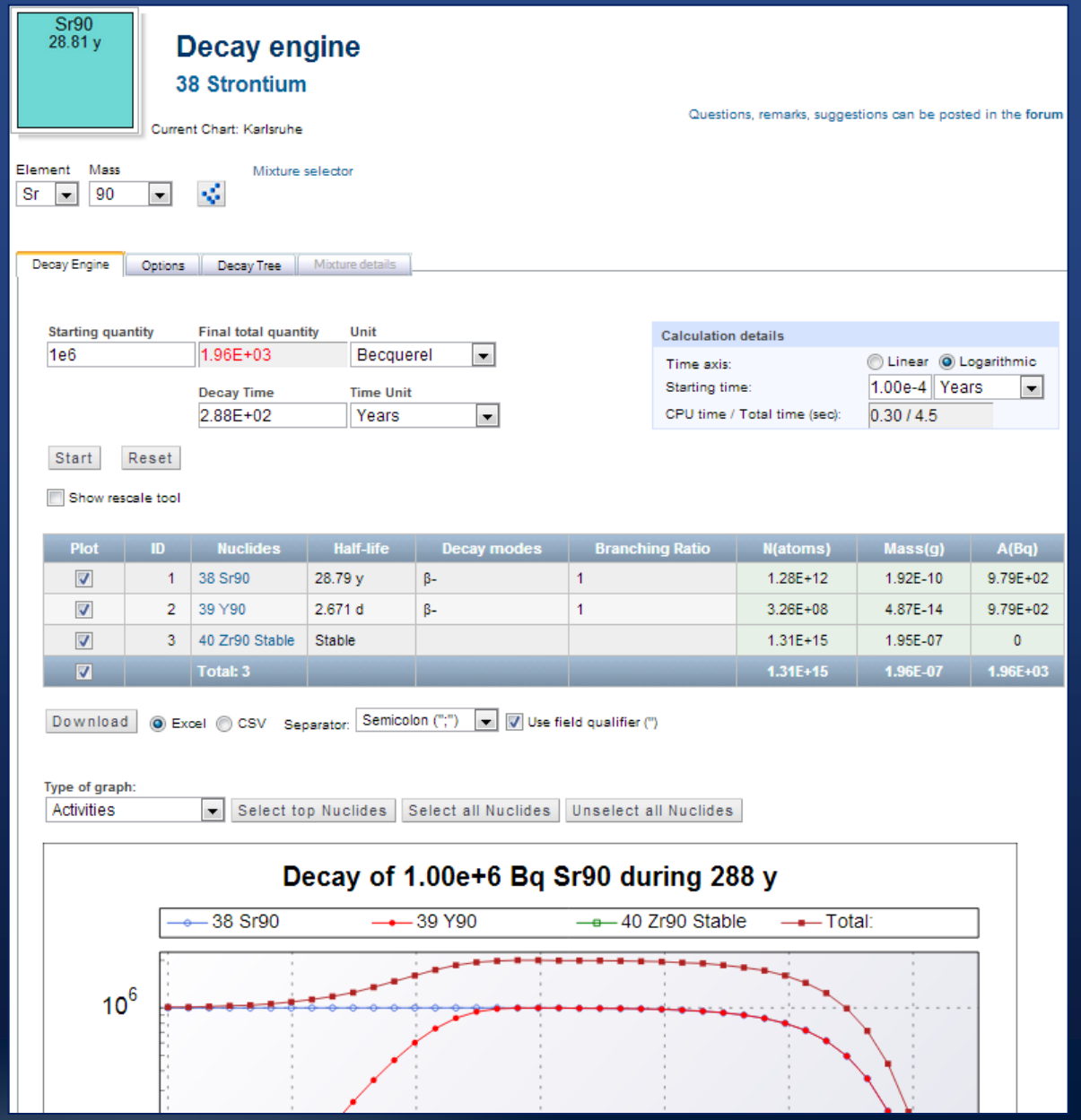
Main Nucleonica database JEFF3.1 contains decay data on 3852 nuclide.



nucleonica

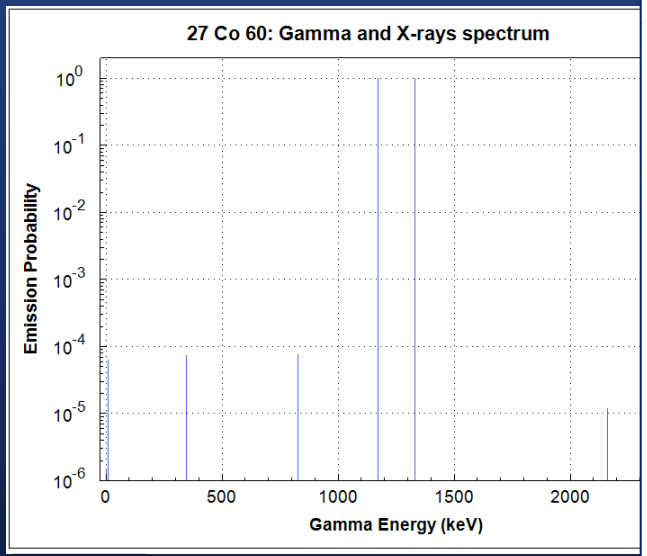
Validated Nuclear Science Applications & Tools

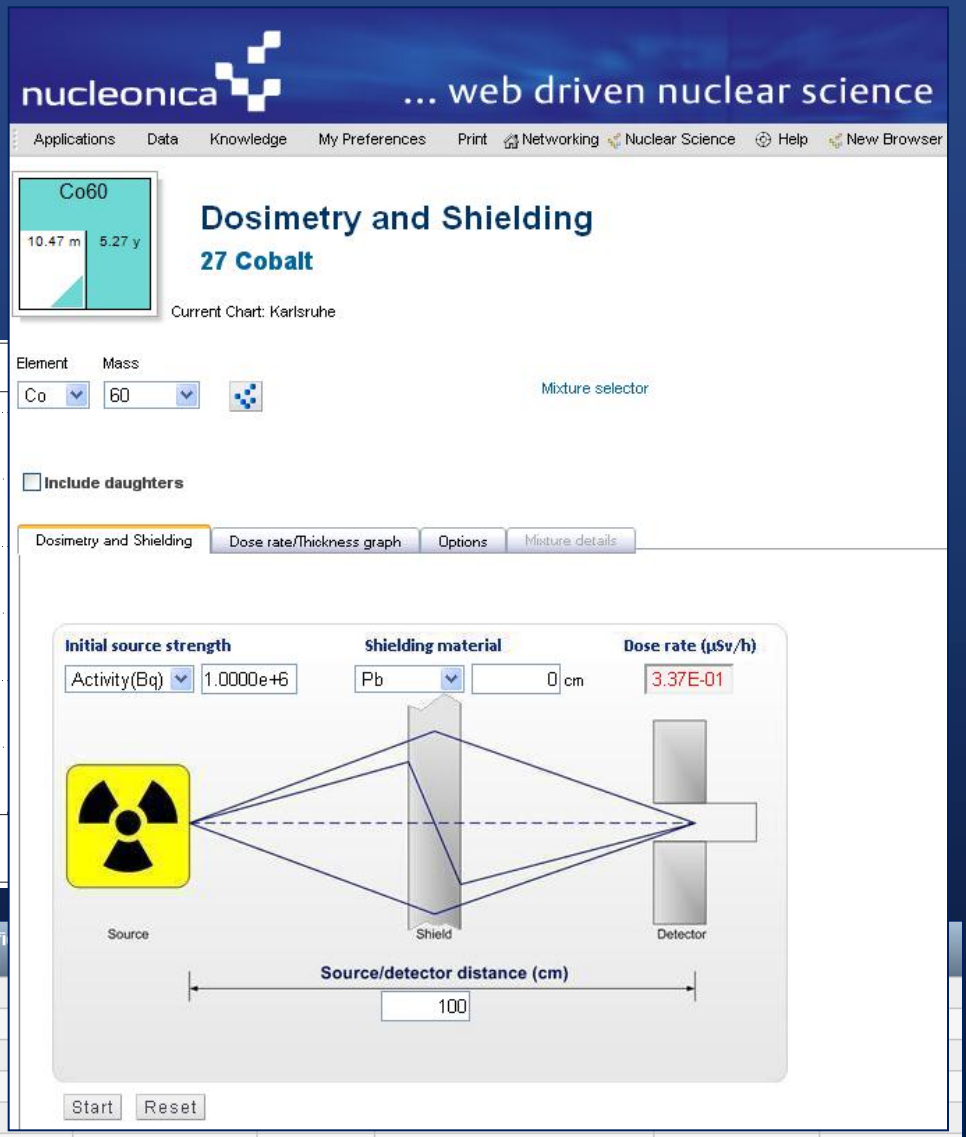
Decay Engine:



Dosimetry & Shielding

The D&S module in Nucleonica allows the user to calculate gamma dose rates from point sources of single nuclides and nuclide mixtures. The user interface is shown in figure.

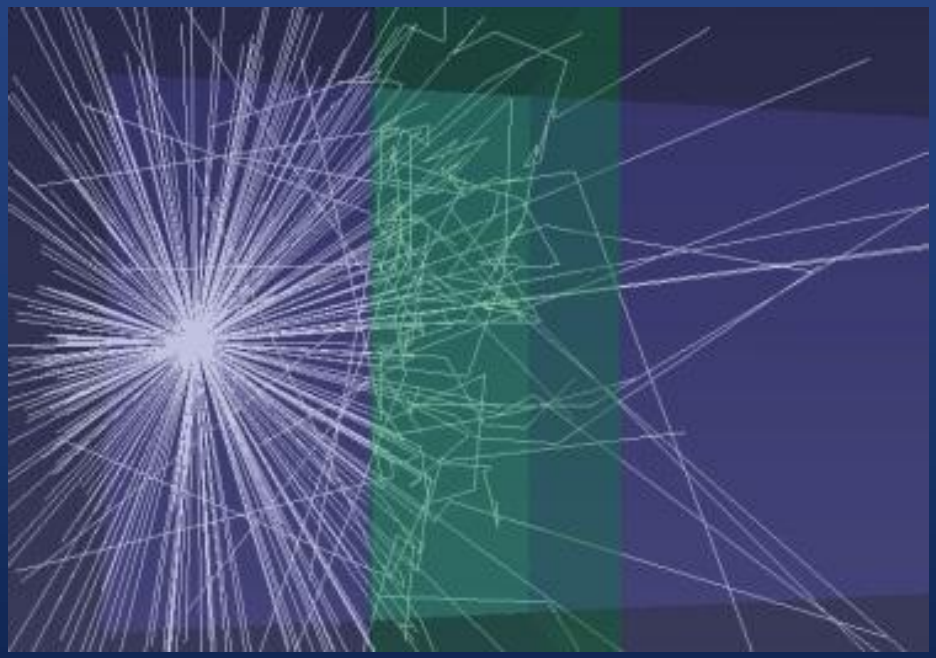




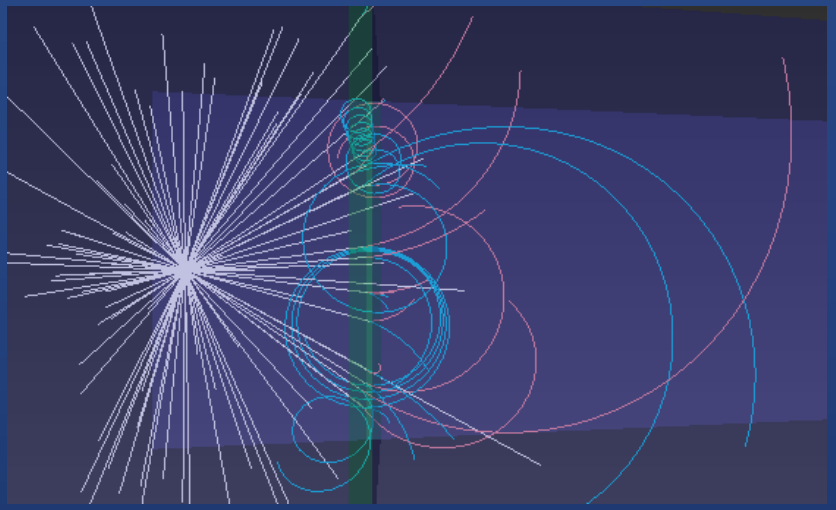
Gamma Energy (keV)	Emission Probability P (per disintegration)	Mass Attenuation Coeffi (shielding)(cm²/g)					
1332.49	1.00E+00	0.00E+00					
1173.23	9.99E-01	0.00E+00					
826.1	7.60E-05	0.00E+00					
347.14	7.50E-05	0.00E+00					
2158.57	1.20E-05	0.00E+00					
2505.69	2.00E-08	0.00E+00	0.00E+00	1.00E+00	2.40E-02	5.51E-09	5.36E-09
7.47815	6.44E-05	0.00E+00	0.00E+00	1.00E+00	1.22E+01	0.00E+00	0.00E+00
7.46089	3.27E-05	0.00E+00	0.00E+00	1.00E+00	1.23E+01	0.00E+00	0.00E+00
8.26	1.31E-05	0.00E+00	0.00E+00	1.00E+00	9.01E+00	0.00E+00	0.00E+00
0.85	1.49E-06	0.00E+00	0.00E+00	1.00E+00	5.38E+03	0.00E+00	0.00E+00
Page: 1 / 1						3.37e-1	3.13e-1

Validated Nuclear Science Applications & Tools

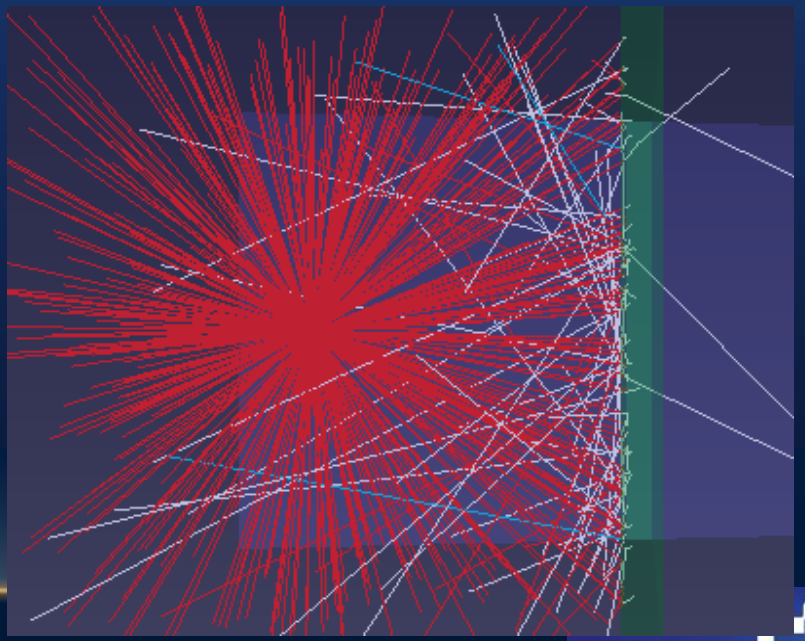
Virtual Cloud Chamber



low energy photons (energy 100 keV) are attenuated with a thick (15 cm) water shield. This combination of low energies and thick shields give rise to multiple scattering of the radiation



Electron-positron pairs are created using 10 MeV photons on lead. By “switching off” energy loss mechanisms, the charged particles are seen to spiral in the applied magnetic field.



The red particles (3 MeV positrons) are blocked by a lead shield (green). When the positrons collide with the shield, they combine with electrons (blue) to create gamma radiation (white). Only a few gamma photons pass through the shield material.

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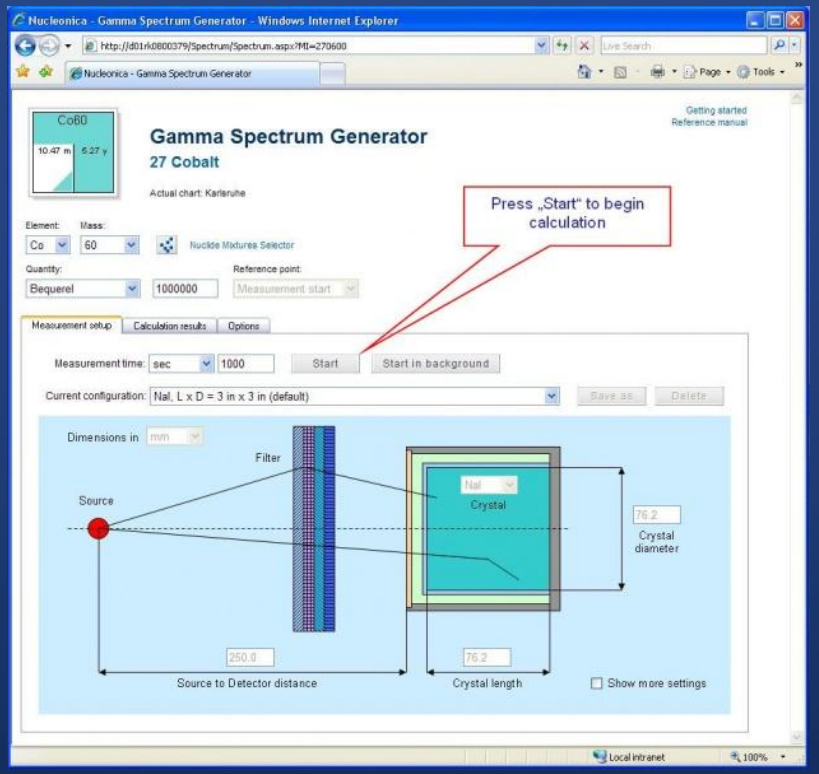
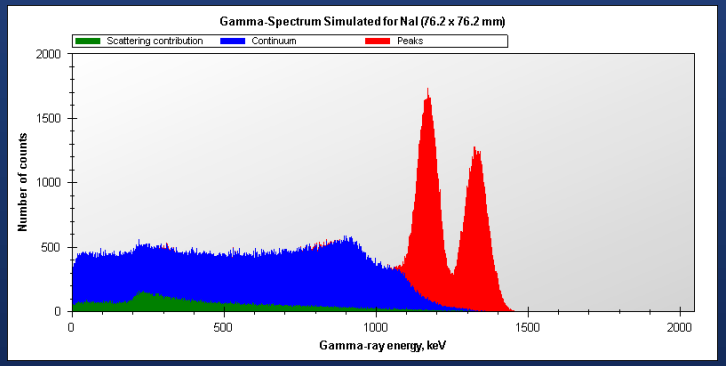
Validated Nuclear Science Applications & Tools

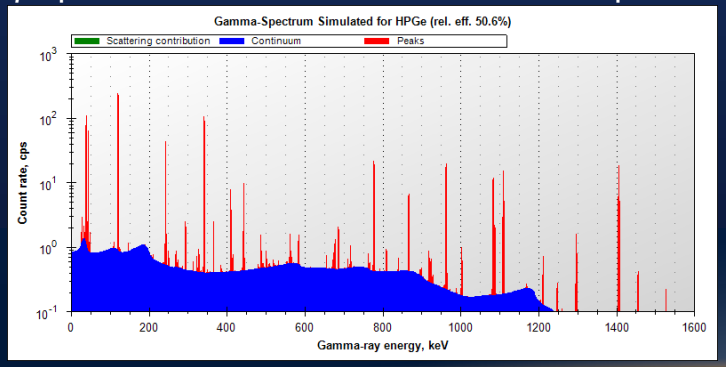
Gamma Spectrum Generator

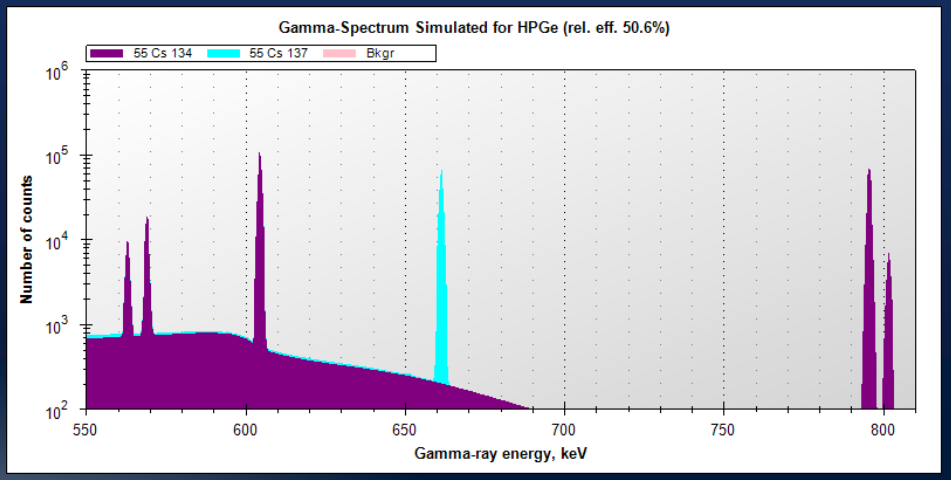


γ-spectrum simulated for ^{60}Co 100 kBq source and NaI (3" × 3") detector:



γ-spectrum simulated for ^{152}Eu 100 kBq source and HPGe detector.





Fukushima: Gamma spectrum of contamination at the Daiichi plant.
Contamination is almost entirely to cesium-137 and cesium -134

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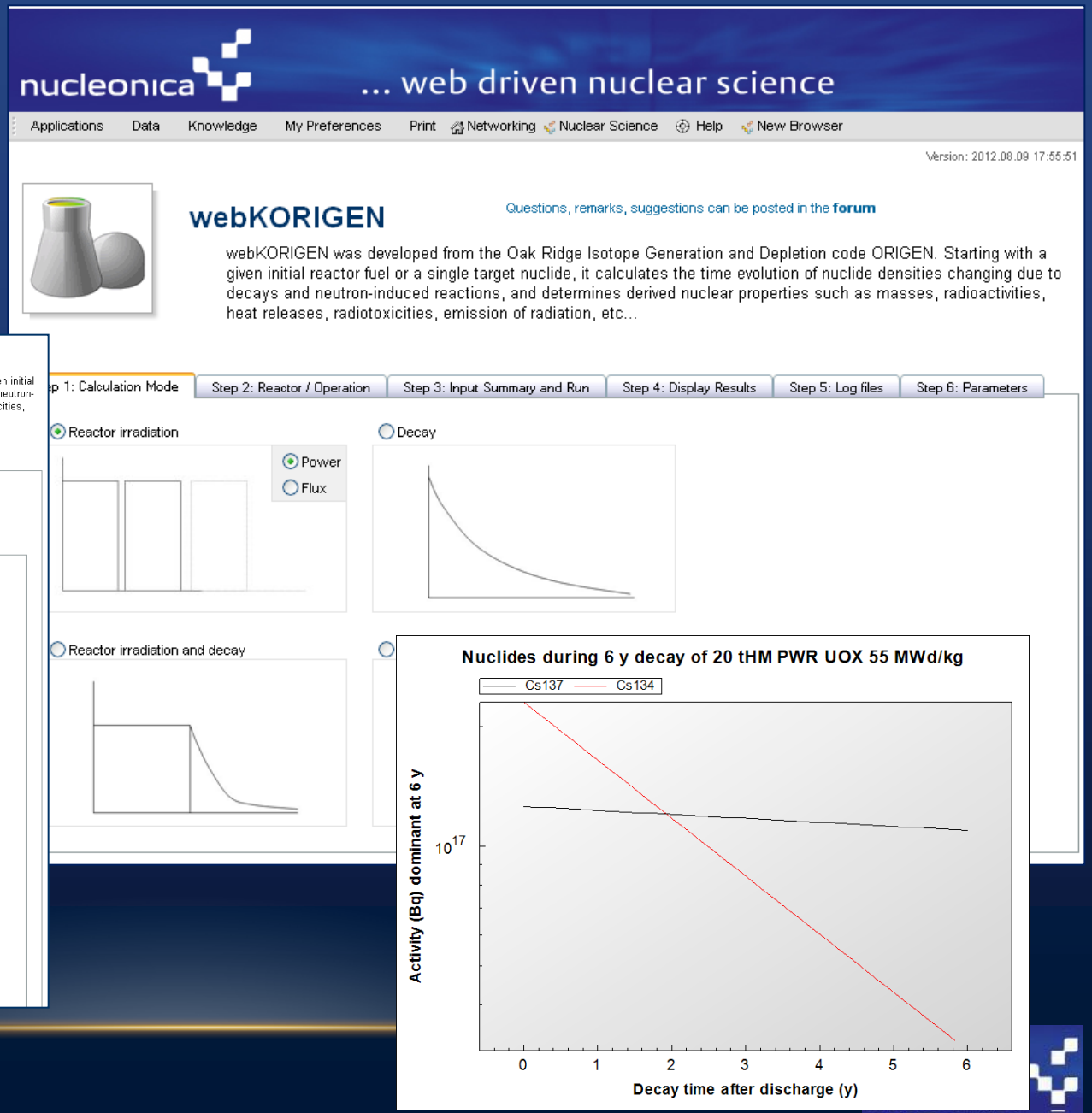
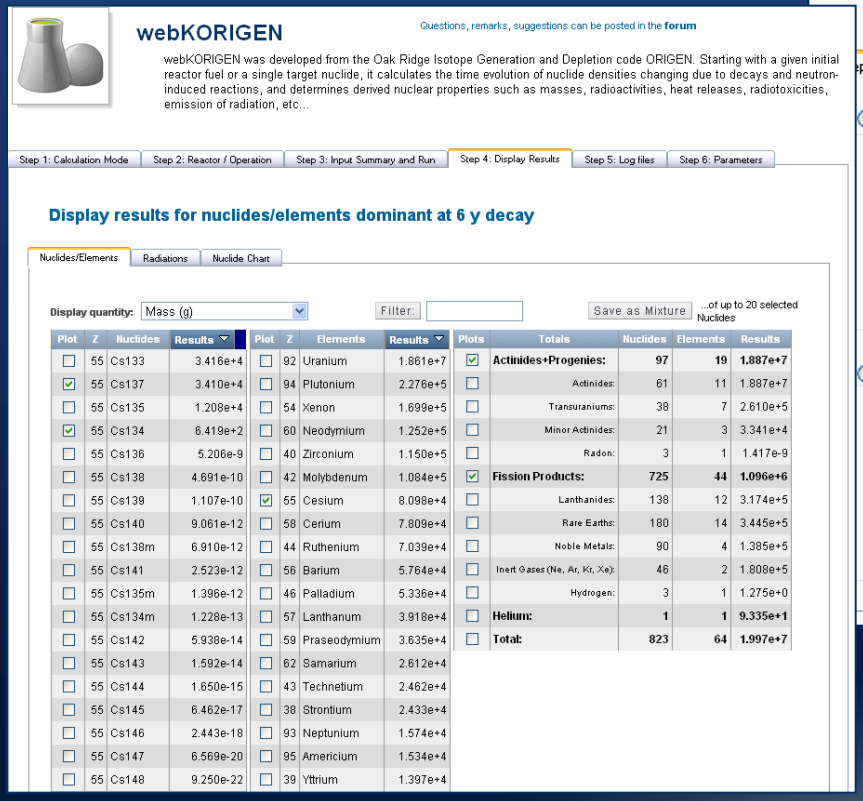
Validated Nuclear Science Applications & Tools

webKORIGEN





Validated Nuclear Science Applications & Tools

e-Ship:

package classification for radioactive transports

Nuclear material transport report

Transport report generated for source: Pu-241 with daughters by magill on 8/14/2012 2:01:20 PM

Source: Pu-241 with daughters
The sample - initially 15mg Pu-241. The sample is cooled for a period of 8 years and is solid, non-special form. the daughters Am-241, Np-237, and Pa-233 Pu-241 - 15 mg, 8 years old - Solid, Non special form
Form: Material, Other form, Solid
Matrix mass: 1 g

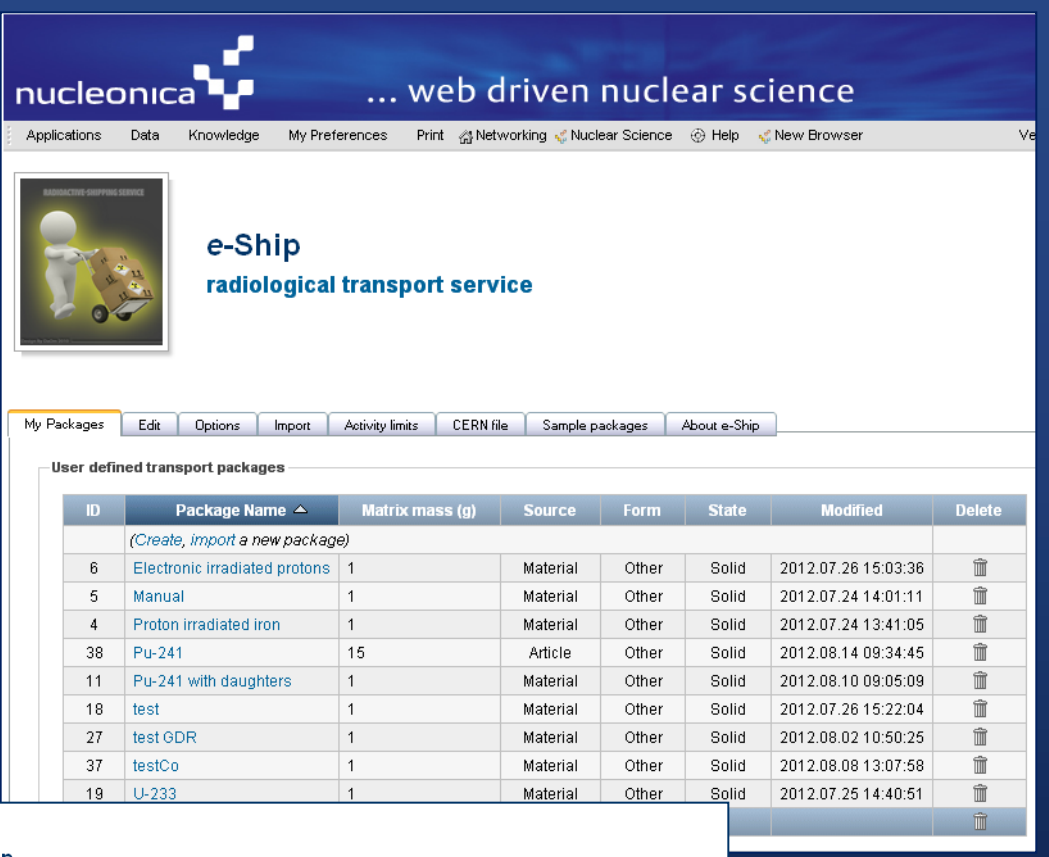
Source characterisation

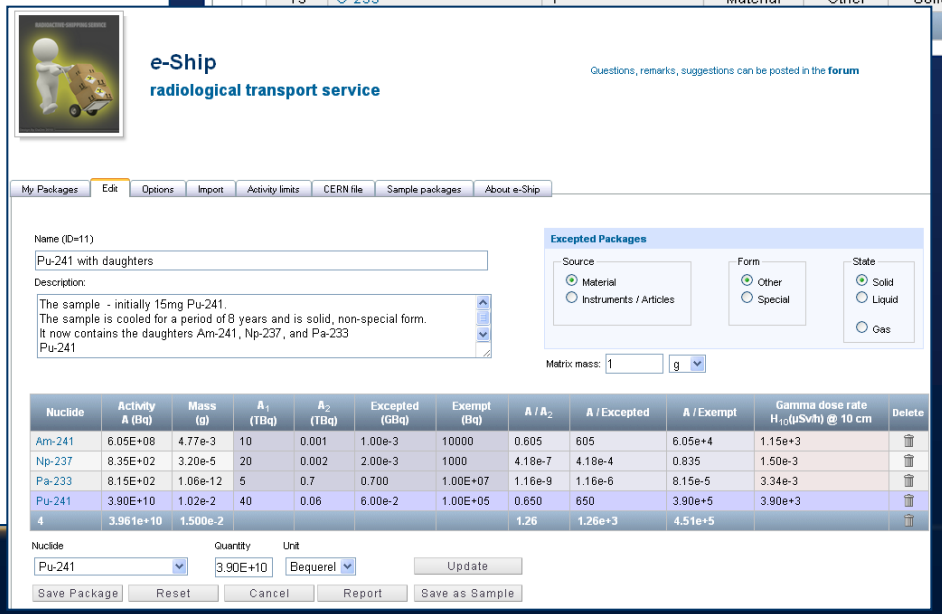
Nuclide	Mass (g)	Activity (Bq)	Heat (W)	Gamma dose rate H_{10}(µSv/h) at 10 cm
Am-241	4.77e-3	6.05e+8	5.44e-4	1.15e+3
Np-237	3.20e-5	8.35e+2	6.59e-10	1.50e-3
Pa-233	1.06e-12	8.15e+2	5.38e-11	3.34e-3
Pu-241	1.02e-2	3.90e+10	3.34e-5	3.90e+3
Total:4	**1.50e-2**	**3.96e+10**	**5.78e-4**	**5.05e+3**

Package characterisation

Nuclide	Activity (Bq)	Exempt (Bq)	Excepted (GBq)	A_2 (TBq)	A / Exempt	A / Excepted	A / A_2
Am-241	6.05e+8	1.00e+4	1.00e-3	1.00e-3	6.05e+4	6.05e+2	6.05e-1
Np-237	8.35e+2	1.00e+3	2.00e-3	2.00e-3	8.35e-1	4.18e-4	4.18e-7
Pa-233	8.15e+2	1.00e+7	7.00e-1	7.00e-1	8.15e-5	1.16e-6	1.16e-9
Pu-241	3.90e+10	1.00e+5	6.00e-2	6.00e-2	3.90e+5	6.50e+2	6.50e-1
Total:4	**3.96e+10**				**4.51e+5**	**1.26e+3**	**1.26e+0**

Type B Package





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Post-graduate research using Nucleonica

Nucleonica is currently being used by students for post-graduate research e.g.:

- Ph.D study of nuclear fuel cycles: The main goal is compare the amount of HLW which is stored and/or disposed for different fuel cycles, normalized to the same energy production.
- MPhil studies on modelling of atmospheric dispersion of radionuclide release from a research reactor. The aim is to compute: a) activity inventories of important radionuclides in the reactor core; b) release fractions; and c) activity released (to the atmosphere).
- Ph.D. studies medical physics: simulation of a HPGe detector used in the laboratory using the Gamma Spectrum Generator application.
- Ph.D. studies on Monte Carlo dosimetry calculations. Development of a general dosimetry and shielding application based on the CERN code GEANT4.
- MPhil studies on performance assessment of a borehole disposal facility for sealed radioactive sources. Various Nucleonica tools will be used for decay calculations, heat generation, gamma emission, neutron emission, external and internal radiotoxicities, etc.

Many of the technical problems arising in the course of these studies have been discussed on the Nucleonica Forum. Finally, we hope to be able to host the final reports from these studies on the Nucleonica web portal.

Education & Training with Nucleonica

Nucleonica for Smartphones: and Tablet PCs: M-Learning

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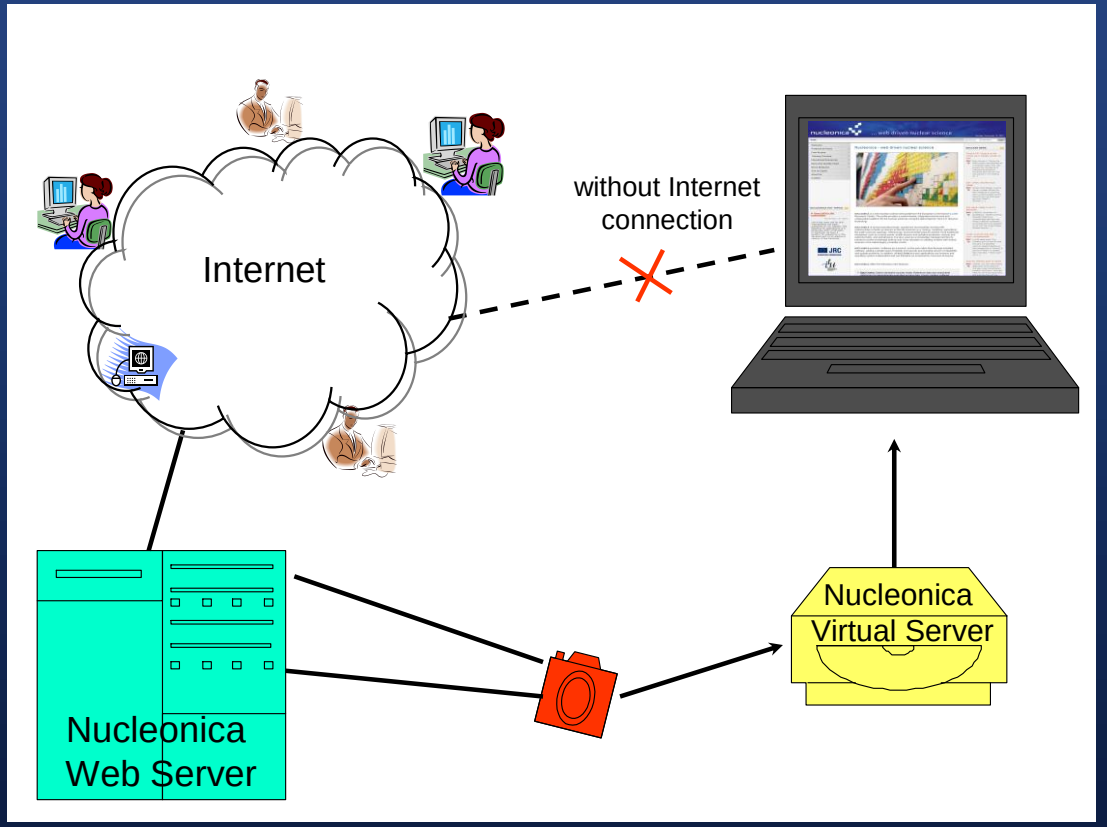
Standalone version of Nucleonica

- specially developed for mobile labs and field workers or for use on Notebooks/PCs where an internet connection cannot be guaranteed
- faster than internet version
- allows for more particles in Monte Carlo calculations than the internet version
- allows Monte Carlo dosimetry and shielding calculations (provided you have an MCNP license!)



Education & Training with Nucleonica

Karlsruhe Nuclide Chart

- Fold-out Chart
- Wall-Chart
- Auditorium Chart
- Nuclide Carpet

Nuclide „carpet“
1m x 6.5m

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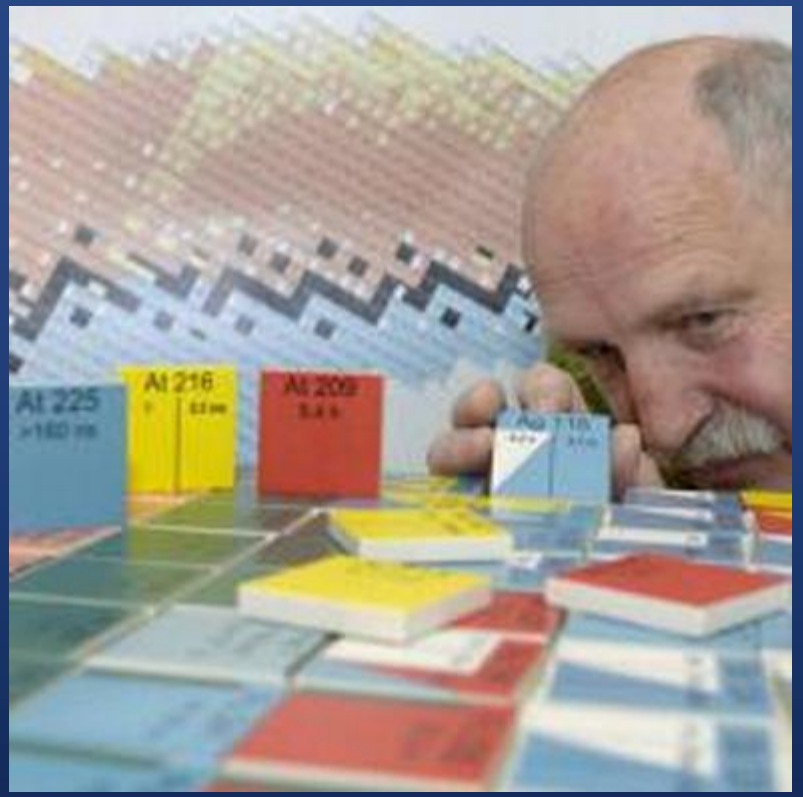
Worldwide unique mosaic of the Karlsruhe Nuclide Chart

A unique mosaic version of the Karlsruhe Nuclide Chart has been developed consisting of 3847 ceramic tiles. The tiles have been produced by Lautertal Ceramics in the Black Forest in southern Germany in co-operation with the Institute for Transuranium Elements and Nucleonica GmbH in Karlsruhe. The mosaic “floor chart” is planned for the new office buildings of the Institute for Transuranium Elements.



The new mosaic chart, 14.85 meters long and 6.70 meters wide – (about 100 square metres) – and weighing three tons, is planned for the “floor” in one of the courtyards of the new building in the Institute for Transuranium Elements.

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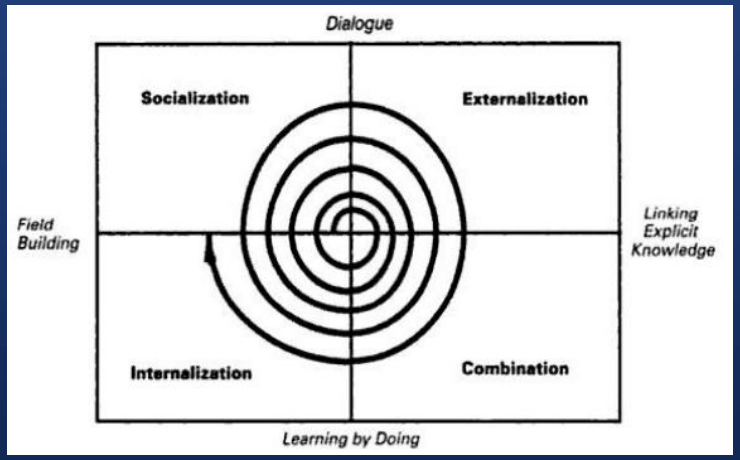
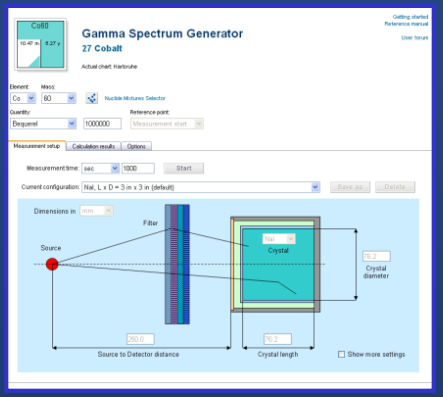
Knowledge Management with Nucleonica

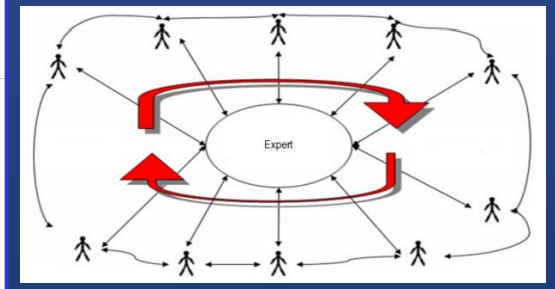
In this slide, the Nucleonica web portal is considered from a knowledge management perspective. Nonaka and Takeuchi have proposed the “knowledge spiral” (shown) in which there are four modes of knowledge conversion: socialization, externalization, combination and internalization (SECI model).



Socialisation: conversion of tacit knowledge to tacit knowledge e.g. an apprentice who works with tutor and learns from observing and imitating the tutor's actions. **Externalization:** conversion of tacit to explicit knowledge. **Combination** is the conversion of explicit to explicit knowledge. The process of systemizing already explicit knowledge into a knowledge system. **Internalization** is the conversion from explicit to tacit, which is closely related to “learning by doing”. At the end of the spiral process, one or more individuals in the organisation have acquired new tacit knowledge.

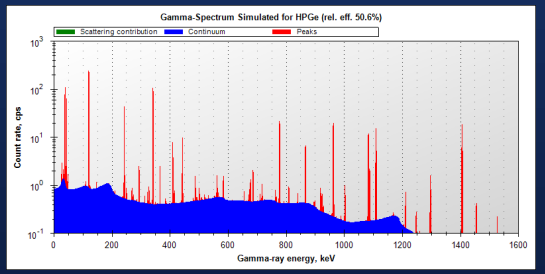


Socialisation: conversion of tacit knowledge to tacit knowledge



Externalization: conversion of tacit to explicit knowledge

Combination: systemizing explicit knowledge



Internalization: conversion from explicit to tacit, triggered through “Learning by Doing”.

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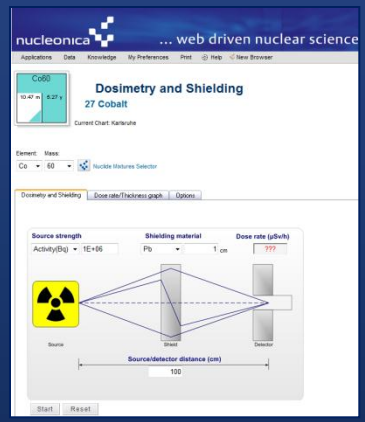
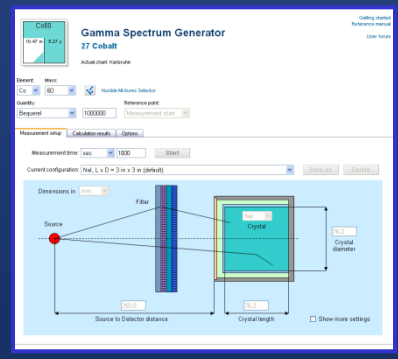
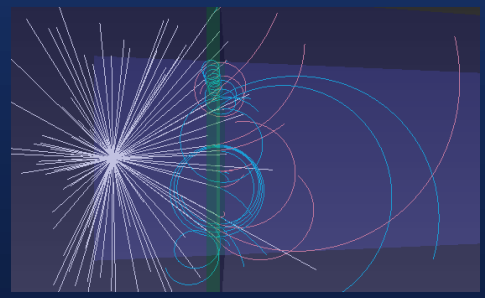
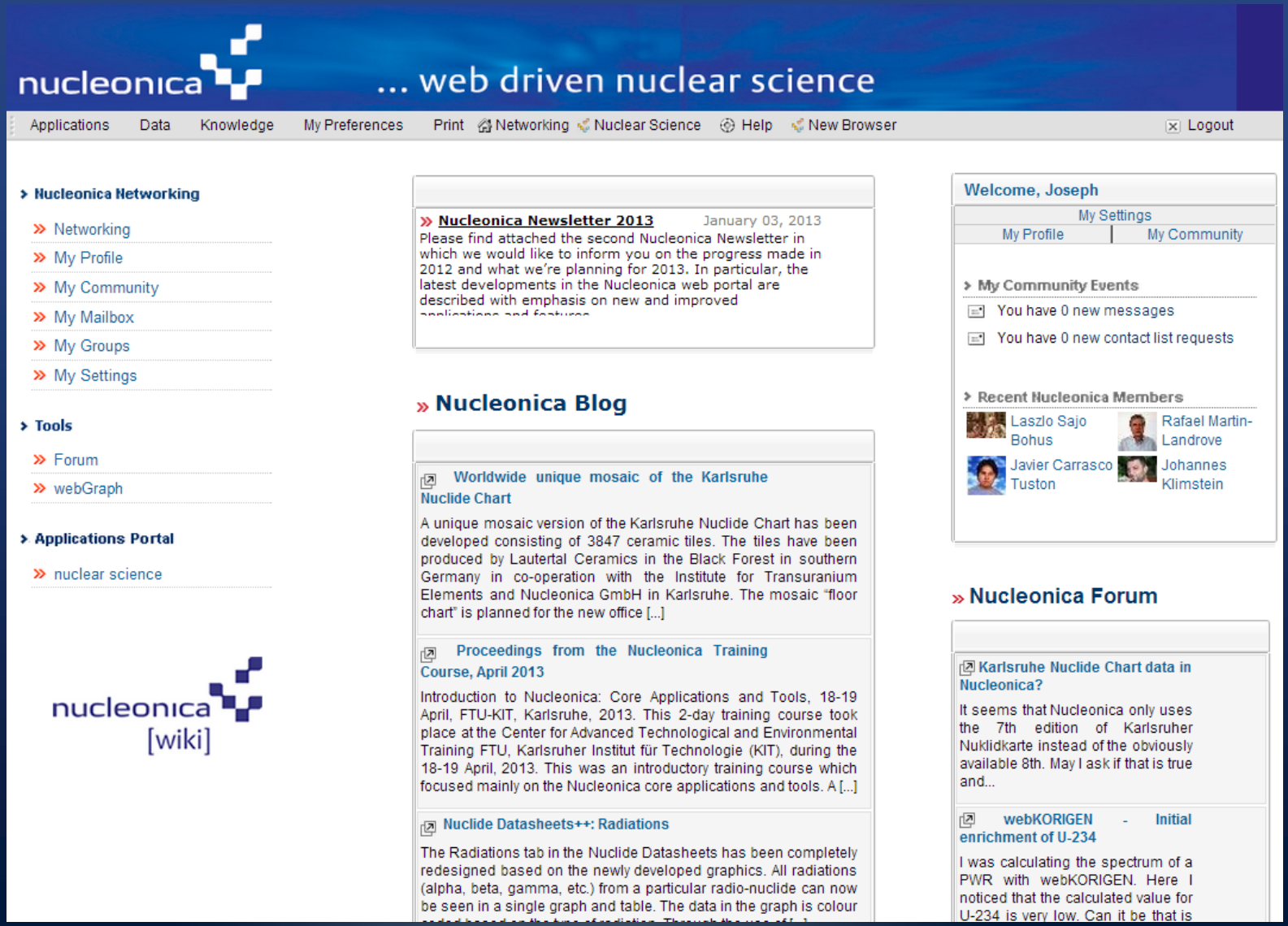
  - Karlsruhe Nuclide Chart
- Knowledge Management with Nucleonica



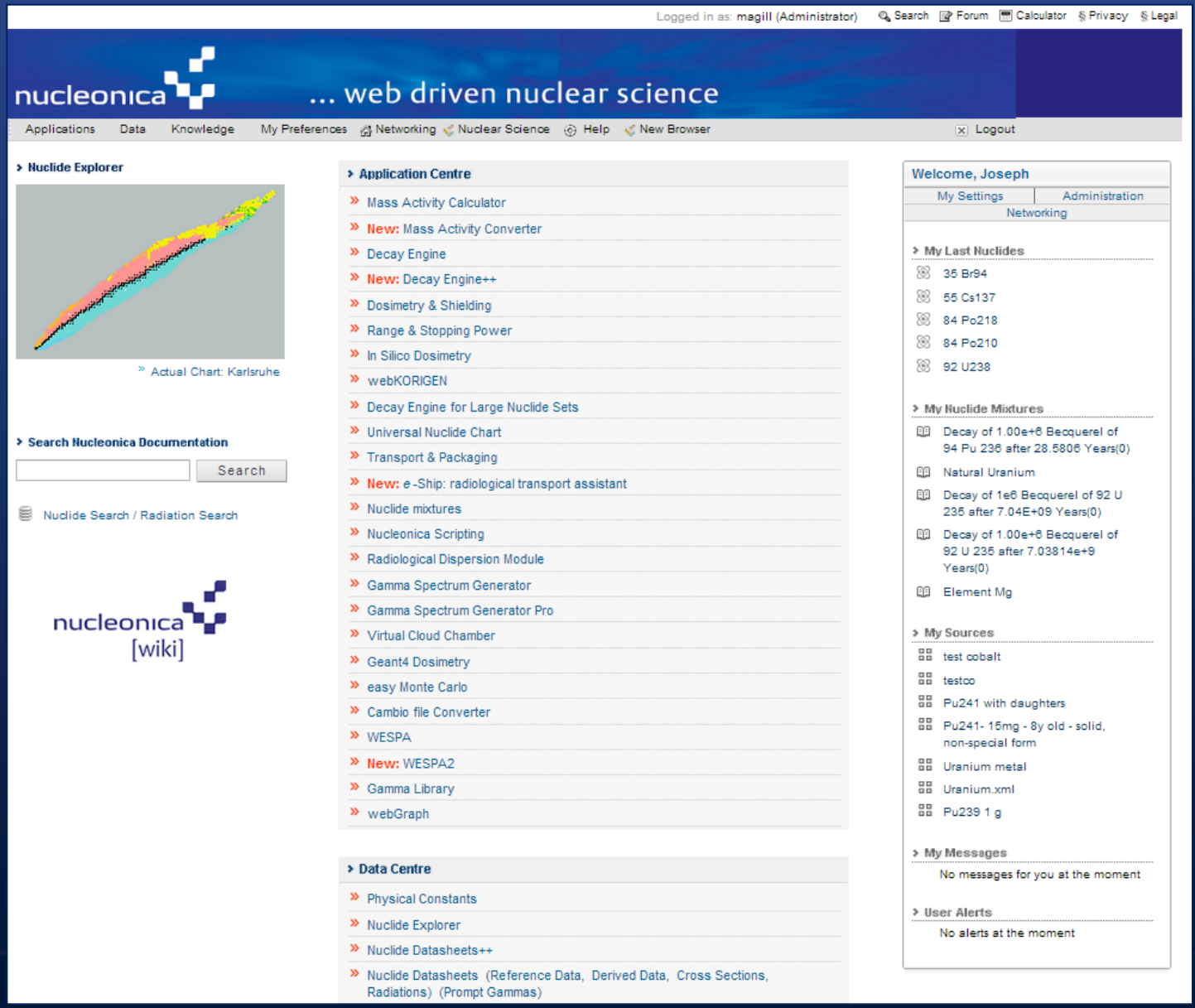




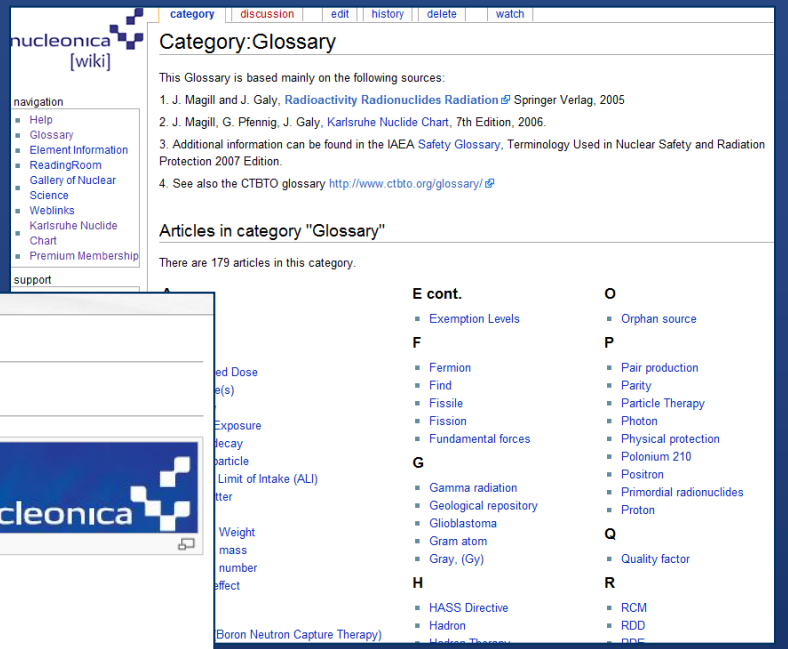
What you see when you login: Networking page - Wiki, Blog, Forum, …

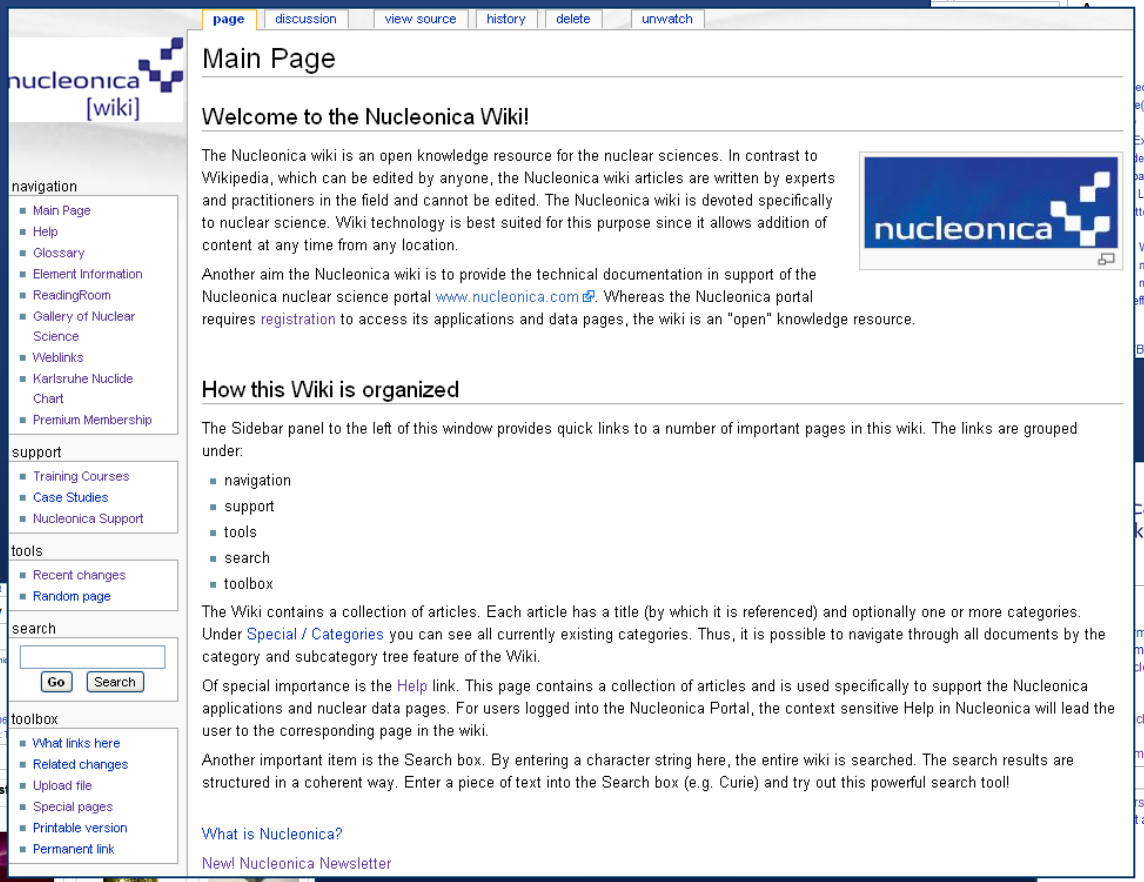


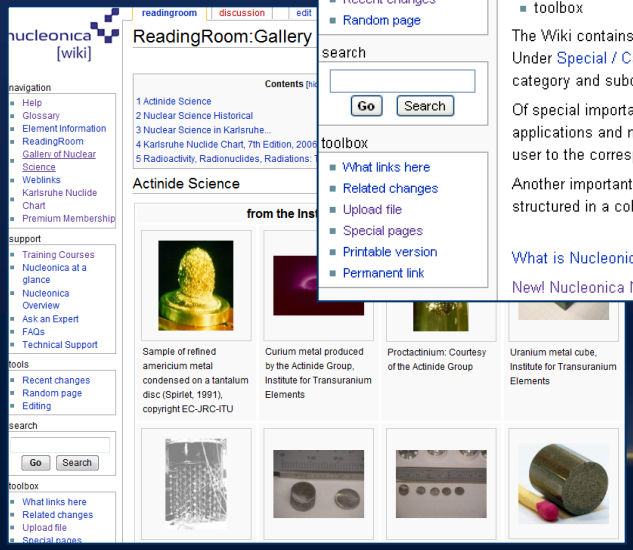
What you see when you login – Nuclear science page

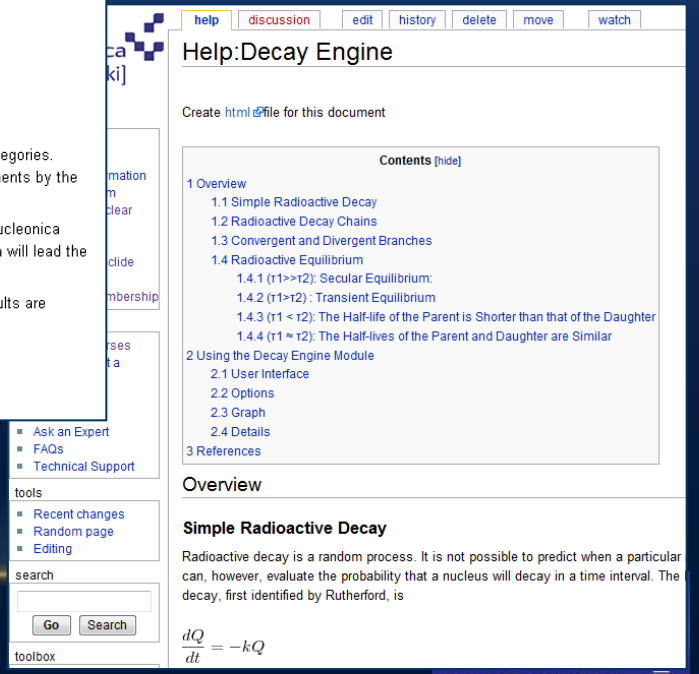


The Nucleonica Wiki…









The Nucleonica Blog…

Start of the Name Approval Process for the Elements of Atomic Number 114 and 116

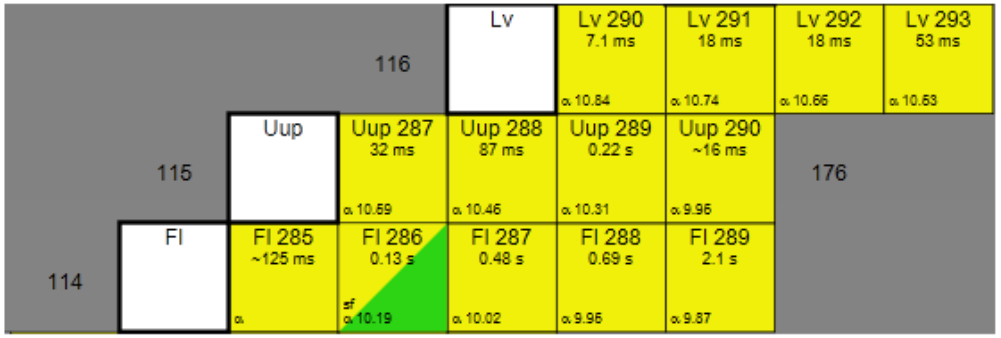
February 19th, 2012

by Joseph Magill

A joint IUPAC/IUPAP Working Party (JWP) has confirmed the discovery of the elements with atomic numbers 114 and 116. In accord with IUPAC procedures, the discoverers proposed names as follows: flerovium and symbol, Fl, for the element with Z = 114 and livermorium with the symbol Lv for the element with Z = 116. The Inorganic Chemistry Division recommended these proposals for acceptance.

Comments should be submitted by 30 April 2012. The text of the Provisional Recommendation can be downloaded from http://media.iupac.org/reports/provisional/abstract11/corish_300412.html.

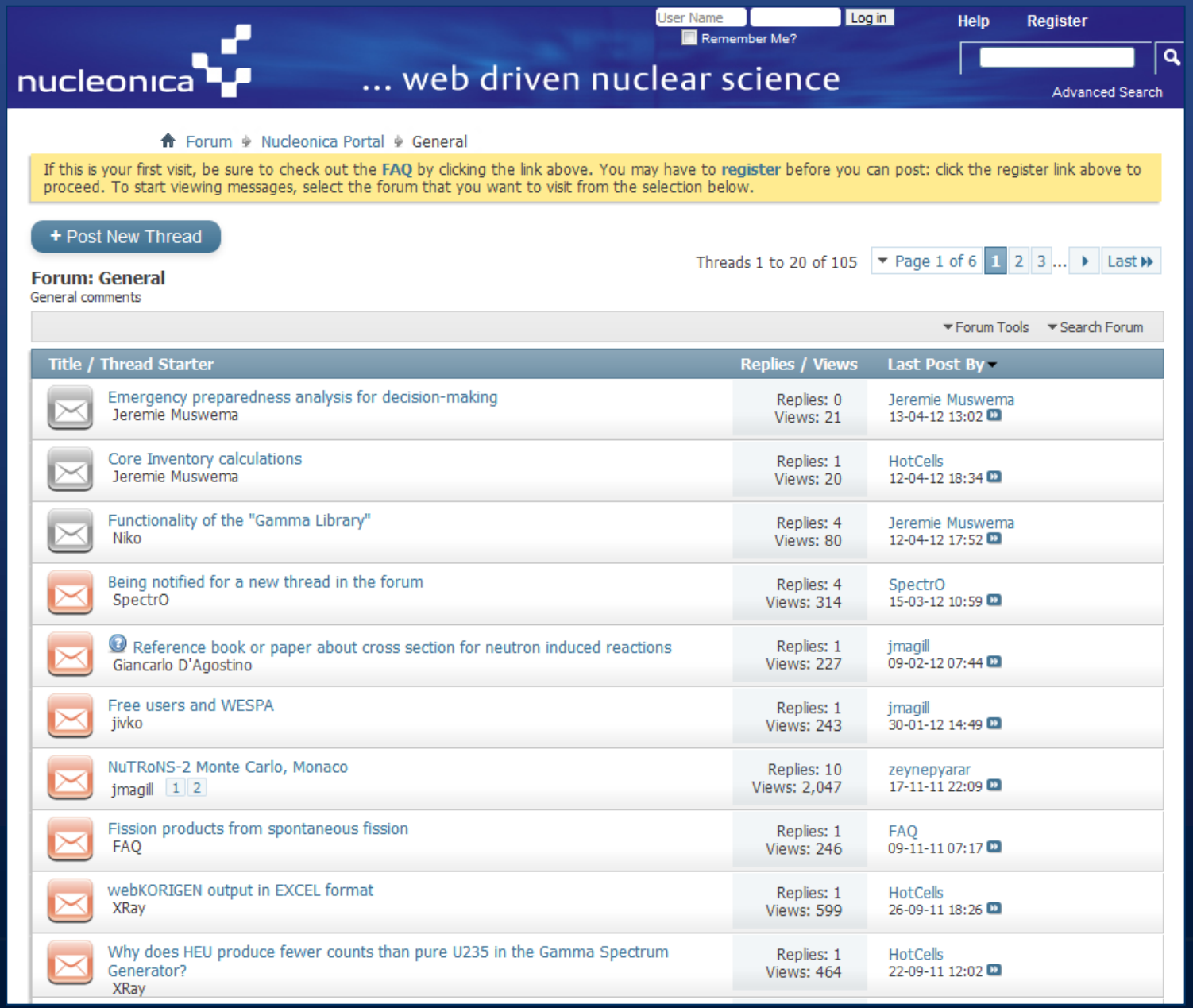
Comments should be sent to Prof. John Corish at jcorish@tcd.ie.



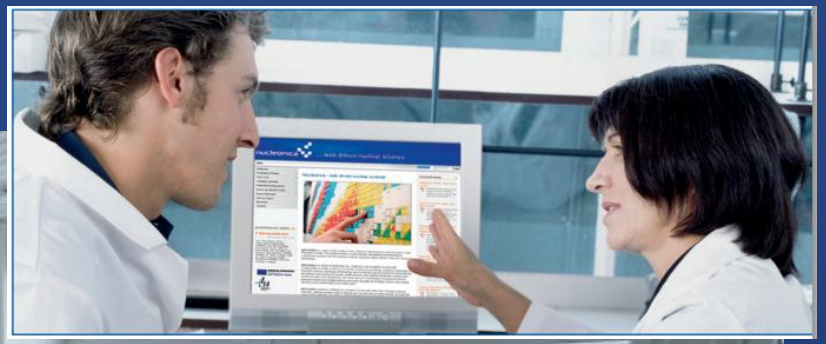
Extract from the new 8th Edition (2012) of the Karlsruhe Nuclide Chart showing the isotopes of flerovium and livermorium.

nucleonica

The Nucleonica Forum…



Training courses...



Thank You!